

# **RANGELAND RESEARCH INSTITUTE (RRI)**

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## **2016-2017 Annual Report**

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**UNIVERSITY OF ALBERTA**  
**FACULTY OF AGRICULTURAL,  
LIFE & ENVIRONMENTAL SCIENCES**  
Rangeland Research Institute

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## 1. Introduction

The University of Alberta Rangeland Research Institute (RRI) has the unique mandate of promoting relevant research, teaching and outreach activities, with a collective goal of improving the environmental and economic sustainability of rangeland ecosystems.

Established in 2011 by the Faculty of Agricultural, Life and Environmental Sciences (ALES), the RRI continues to undertake a wide variety of research in support of understanding how rangelands inherently function, and improving their stewardship under ongoing land uses such as grazing, energy extraction and recreation. While focused to a large extent on the University of Alberta Mattheis and Kinsella Research Ranches, the footprint of the RRI extends well beyond these locations. The RRI also uses numerous privately owned land bases and publicly owned and administered grazing leases, allotments and community pastures across Alberta and beyond, thereby ensuring widespread applicability of its scientific work.



**Prairie coneflower, July 2016.**  
**Photo: Lisa Raatz.**



**Entrance to the Mattheis Research Ranch in southeast Alberta.**

This report summarizes key activities undertaken by the RRI from April 1, 2016 through March 31, 2017. Included is a brief overview of research activities, including overviews of three recently completed projects conducted on Alberta rangelands; an update on activities associated with expanding research capacity; a summary of major communication and outreach activities for the RRI; a review of the RRI Strategic Advisory Council role; as well as a financial summary of the previous year.

## 2. Research

Rangelands are important terrestrial ecosystems across the globe, with grasslands and shrublands covering approximately 40% of the earth's terrestrial surface, including large regions of western Canada. Alberta contains more than 10 M ha of native grassland and tame pasture, which combined, provides forage for nearly half of the Canadian beef cattle breeding herd.

Additionally, public land across all of the western provinces in Canada is utilized to provide substantial amounts of the summer feed supply for livestock, and includes sizeable forested areas of parkland, boreal and mountainous habitat. Collectively, these complex ecosystems sustain livestock, wildlife, ranchers, and both rural and urban communities by supplying a wide

variety of ecological goods and services (EG & S). While the historical role of rangelands in providing forage for the livestock industry is relatively well-known, the key role that these areas play in providing other critical environmental services is only recently being addressed in research. The latter includes greenhouse gas mitigation and carbon sequestration, the conservation of habitat and biodiversity, as well as pollution abatement and flood control. To date, many of these services, considered crucial for human existence, remain poorly understood and un-quantified. Consequently, limited policy exists to reward private landowners and rangeland managers for maintaining or enhancing them. By focusing research attention on rangelands, the RRI aims to build a more complete understanding of the complex ecological function and socio-economic value of these important activities for all Canadians.

During 2016-17, researchers affiliated with the RRI addressed a wide range of topics of key importance to those concerned with sustainable rangeland management. Research topics included cattle grazing behavior and feed efficiency, grazing system and accompanying management impacts on forage agronomy and rangeland biodiversity, invasive species mapping and evaluation, the assessment of pollinator diversity and



**Scenic view overlooking the Red Deer River.  
Photo: Lisa Raatz.**



associated functional impacts in agro-ecosystems, soil re-vegetation following industrial disturbance, as well as soil nutrient cycling dynamics, carbon storage and greenhouse gas (GHG) mitigation. A partial list of these projects is shown in Appendix I. Summary of ongoing research projects led by RRI affiliates.



**Harebells in native grassland at Mattheis Research Ranch.**  
**Photo: Lisa Raatz.**

Many of these activities took place entirely or partially on the Mattheis and/or Kinsella Research Ranches, each of which is approximately 5000 ha in size, and effectively serve as dynamic 'living laboratories' within the Mixedgrass and Aspen Parkland natural sub-regions, respectively. These land bases enable researchers to conduct a variety of studies ranging from *in-situ* retrospective assessments of existing biota, to manipulative, controlled experimental studies of ecosystem responses to a variety of human land uses or other natural disturbances. This network is further enhanced by the establishment of the Stavely and Onefour Research Ranches. These publicly owned and managed land bases are found in the Foothills

Fescue and Dry Mixedgrass prairies of southern Alberta, and provide additional opportunities to test important research questions in a wider variety of vegetation, soil and climatic conditions.

A total of 46 individual researchers, including 10 principle scientists, 19 graduate students, 12 undergraduate students, as well as 17 visiting scientists, post-doctoral fellows and senior technicians, spent time on the Mattheis Research Ranch during 2016-2017, spending 817 person-days at the facility. Most researchers were from the Faculty of ALES, although there were also



**Mattheis Ranch yard after a July thunderstorm.**  
**Photo: Lisa Raatz.**

several from Biological Sciences and Earth and Atmospheric Sciences. Additionally, the Mattheis Ranch was visited by researchers from the University of Calgary, University of Lethbridge, University of Manitoba, Agriculture and Agri-Food Canada, Environment Canada, Alberta Environment and Parks, Livestock Gentec, Alberta Agriculture and Food, Agricultural Financial Services Corporation, the Alberta Biodiversity Monitoring Institute, and Weyerhaeuser. These projects are generally highly collaborative in nature and many involve numerous study sites distributed regionally across the province. Having multiple study sites is critical in ensuring that research results apply to as broad a range of agro-climatic conditions as possible, and they also contribute greatly to public outreach by providing local sites for demonstration through field tours and workshops. Along with collaboration from public land agencies (i.e. Alberta Environment and Parks), a number of projects have strong participation from private organizations, which helps maintain relevance to issues of significant concern to ranchers and industry.



**Blue grama at sunset in fall, Mattheis Research Ranch.  
Photo: Lisa Raatz.**



### 3. Research Profiles

#### *Intermittent Defoliation Impacts on Mixedgrass Prairie*

Prepared by E.W. Bork

Controversy exists over whether rotational grazing systems can favorably alter forage growth and native grassland composition. Rotational systems entail dividing large areas of grassland into smaller pastures to better control the timing and frequency of livestock grazing during summer. This, in turn, may alter the pattern and amount of forage grown throughout the growing season, as well as maintain desirable plants by equalizing stress on all vegetation during grazing events. These benefits may be limited within the Mixedgrass Prairie, however, where plant communities are relatively homogenous, the growing season is short, and annual moisture deficits commonly restrict vegetation growth by late July.

A recent PhD study conducted on the Mattheis Research Ranch by Dr. Tanner Broadbent examined season-long forage yield and plant composition responses of two



**A new mom at Mattheis Ranch calving pasture.**

**Photo: Hanna Schoenberg.**

mixed grasslands to different defoliation regimes under ambient and elevated moisture conditions over a 5-year period (2010-2015). Results showed that defoliation and moisture divergently altered plant growth and composition, with responses further dependent on the initial composition of the grassland and its local moisture status. In moister areas where western wheatgrass (an important forage species found across SE Alberta) was normally dominant, high

intensity recurrent defoliation during summer reduced biomass due to low regrowth. This finding suggests that both high density cattle grazing (to achieve uniform use) and recurrent 'patch' defoliation under continuous (i.e. free-choice) grazing, may both negatively impact this valuable grass. In contrast, needle-and-thread grass, which dominates drier areas of the mixedgrass landscape, was surprisingly found to be more tolerant of repeated summer defoliation than previously thought. High intensity defoliation was generally more likely to maintain productivity where shorter-statured and more grazing tolerant native grasses were prevalent, such as June grass and blue grama. While moisture addition generally increased productivity, it did not ameliorate

the negative impacts of frequent, intense defoliation on plant growth during the growing season. Overall, defoliation increased total plant diversity in mesic mixed grassland by reducing dominance of tall-statured and highly competitive species such as western wheatgrass. In contrast, defoliation had less impact on the floral diversity of arid mixedgrass prairie.

This study has refined our understanding of how defoliation and moisture interact to alter mixedgrass composition, diversity and production, including the tradeoff between maintaining forage availability and grassland composition. By addressing mechanisms regulating vegetation dynamics, this study helps explain where, when and how benefits of rotational grazing are likely to occur in mixedgrass prairie. Additional investigations underway are working with ranchers employing specialized rotational grazing systems across western Canada to further understand the impacts of this practice on a suite of ecosystem goods and services, including forage production, biodiversity, carbon storage and greenhouse gasses. For more information on the results of this project, please contact Dr. Edward Bork ([edward.bork@ualberta.ca](mailto:edward.bork@ualberta.ca)).

### *Silvopastures promote carbon storage and reduce greenhouse gas emissions*

*Prepared by E.W. Bork*

Concerns over rising CO<sub>2</sub> levels and associated global temperatures have raised questions about the impact of land use management practices on carbon (C) stores and the flux of greenhouse gasses (GHGs) such as CO<sub>2</sub>, as well as more potent gasses such as methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). A recent study completed at the University of Alberta by Dr. Scott Chang and colleagues examined the effects of three different agroforestry systems on GHG emissions, and provided unique insights into the benefits of not only forests, but also perennial grassland, in helping counteract emissions of GHG.



**An example of an agroforestry system, canola field with shelterbelt.**

**Photo: Ferrah Fatemi.**



Agroforestry systems are land areas where trees and either cropland, pasture, or a combination thereof, are deliberately combined in the landscape to maintain greater production efficiency and environmental sustainability. Across western Canada, agroforestry takes many forms, and includes the retention of woody hedgerows at field margins, the planting of shelterbelts, and in moister areas, the grazing of silvopastures, wherein cattle are provided access to a mosaic of grassland and patches of naturally occurring forest. The study, which included a comparison of hedgerow-cropland, shelterbelt-cropland, and natural parkland silvopastures at 36 sites across a climatic gradient in central



**Forest understory grazing by cattle.**  
**Photo: Ferrah Fatemi.**



**Collection of air samples for greenhouse gas emissions studies using a static chamber.**  
**Photo: Ferrah Fatemi.**

Alberta, revealed that those agroforestry systems containing annual cropland were more likely to have lower surface soil C stocks, increased GHG emissions, and therefore a net increase in the global warming potential. Increased warming potential in turn, has implications for the rate of climate change and the ability of agroecosystems to support sustainable socioeconomic activities. As expected, forested components of these systems stored large amounts of C. An unexpected

finding, however, was that the silvopasture system, comprised of a mix of aspen forest and perennial grassland, resulted in up to 24% greater shallow soil C. When combined with a 15% higher CH<sub>4</sub> uptake and 44% lower N<sub>2</sub>O emissions, the silvopasture had the greatest ability to counteract global warming. Enhanced C storage and reduced GHG emissions in silvopastures were attributed to the presence of perennial vegetation throughout this agroforestry system, with large C inputs and retention likely to maximize C accumulation.

These findings are particularly important as they reveal that agricultural management strategies seeking to maximize C storage should strive to both maintain and enhance forests where possible, but also retain perennial pastures and minimize their conversion to cropland. This in turn, further highlights the compatibility of silvopastures and associated livestock production with maintaining this important ecosystem service. For more information on this project, please contact Dr. Scott Chang ([scott.chang@ualberta.ca](mailto:scott.chang@ualberta.ca)).

### *Smooth brome invasion into Alberta's native grasslands*

*Prepared by G. Stotz*

Globally, invasive species pose one of the greatest threats to biodiversity and ecosystem function. Forage species that are widely planted and bred represent a source of potentially invasive species, due to their ability to colonize and disperse into surrounding native grasslands. Smooth brome (*Bromus inermis* Leyss.) is one such species. It was introduced to North America in the late 1800s as a forage crop, and it is still being bred and actively planted in Canada. It escapes planted areas, and is found aggressively invading native habitats across Canada. Where long-established, smooth brome forms dense patches in the landscape. Since smooth brome is also an economically important species, it is necessary to understand the mechanisms and consequences of its invasion across Alberta's grasslands.



**Example of a transect used to monitor smooth brome invasion and its impact on community structure and function.**



**University of Alberta researchers sampling along transects of smooth brome invasion. Photos: Gisela Stotz.**



A recently completed study across the province by researchers from the University of Alberta at 8 sites with varying moisture and productivity (from Grande Prairie to the border with Montana) revealed smooth brome had a consistently negative impact on other plant species. Over half of other plant species were excluded from smooth brome invaded areas, mostly due to shading. This consistent impact is likely explained by the introduction of different cultivars, bred to perform well under varied conditions. Interestingly, although smooth brome consistently reduced native species richness, its impact on exotic plant species was variable, having no impact on exotic species in several sites. This can have important management consequences, potentially resulting in secondary invasions or an even greater impact on native species richness.

However, smooth brome success and dominance may not be long lasting. Although no evidence of 'invasion retreat' has yet been observed, smooth brome performance is likely to decrease over time due to negative feedbacks within the ecosystem. Smooth brome alters soil conditions where it invades, increasing nutrient availability. In contrast, brome growth and competitive ability decreased when growing in its own soil relative to soil from native-dominated areas. Although further investigation is needed, evidence points to the accumulation of soil pathogens. This may offer an important opportunity to manage the impact and further expansion of smooth brome.

Results from this project demonstrate the importance of evaluating and taking into account the impact planted forage species can have on natural ecosystems when assessing whether to continue planting or introducing new cultivars. Further studies are also needed, as understanding the mechanisms of invasion may help to



**Smooth brome patch in a native grassland in the U of A Roy Berg Kinsella research station.**



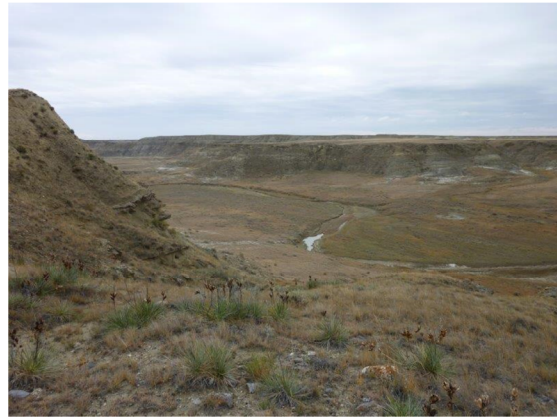
**Smooth brome patch from above. Photos: Gisela Stotz.**

continue taking advantage of these economically important species, while preventing further losses in biodiversity. For more information on this project, please contact Dr. Gisela Stotz ([gstotz@ualberta.ca](mailto:gstotz@ualberta.ca)).

#### 4. Capacity Building

The 2016-17 year was marked by several key events critical to further enhancing the capacity of the RRI and its ongoing activities. The first was the formal ratification of a Memorandum of Understanding (MOU) between the University of Alberta and Alberta Environment and Parks in December of 2016. The MOU provides a common framework integrating research and outreach activities at the Onefour and Stavely Research stations into these working rangeland landscapes, and includes livestock production and the maintenance of a host of rangeland landscapes.

Both locations have a rich history of scientific enquiry and public outreach, as these were part of the Agriculture and Agri-Food Canada network of research stations until recently. Following the shut-down of these facilities by the federal government in 2014, the Government of Alberta, as the primary administrator of these lands, and the University of Alberta, embarked on discussions to help ensure that the legacy of these important land areas would continue to support rangeland research, teaching and outreach. Ultimately these discussions culminated in an MOU that provides the University of Alberta with a key voice in the



**South end of Onefour Heritage Rangeland Natural Area. Photo from Barry Adams.**



**Stavely Research Ranch. Photo from Barry Adams.**

activities taking place on these public grazing lands. The University of Alberta will play an important role in preserving the history of previous long-term research projects taking place on these lands. This includes for example, the long-term stocking rate project at Stavely, which has been underway since 1949, and the grassland monitoring study at Onefour that dates back to the mid 1920's. Located in the Dry Mixedgrass and Foothills Fescue regions, respectively, Onefour and Stavely provide additional 'living laboratories' that are highly complementary to the Kinsella (Parkland) and Mattheis (Mixedgrass) Research Ranches. These research stations greatly expand the core infrastructure available to other biophysical environments for the testing of questions relevant to rangeland stakeholders across Alberta. Perhaps equally important, the maintenance of these stations provides additional opportunities to achieve improved training of highly qualified personnel, as well as maintain outreach to local area ranchers.



**L-R: U of A President Dr. David Turpin, ALES Dean Dr. Stan Blade, and Agriculture and Forestry MLA Honorable Oniel Carlier. Announcing MOU partnership between UofA and Alberta Environment and Parks to preserve research legacy of Stavely and Onefour Ranches.**

Second, we have continued to grow the Rangeland Ecology and Management Fund (REMF), which is a key component of the infrastructure for the RRI. The REMF was established in 2015 to provide the resources needed to ensure that the RRI can continue to meet its goal of becoming a leading center for rangeland research, teaching and training in the long-term, including the dissemination of beneficial management practices impacting all rangelands. Our short-term goal is to grow the REMF as quickly as possible to both meet our obligation under the conservation easement, and also move expeditiously towards long-term financial security in the face of potential declining external revenue sources to the RRI. Much of the initial investment in the REMF is associated with proceeds arising from the placement of a Conservation Easement on the Mattheis Ranch. This easement provides an added layer of environmental protection to the unique ecosystems of the property by preventing further cultivation, subdivision



and wetland draining, while still allowing for both research and continued agricultural land use.

The RRI also builds capacity by attracting researchers through the Competitive Grants program. During 2016-2017, the 4<sup>th</sup> call for Competitive Grants was held through the RRI. Three projects were approved for funding beginning in the summer of 2017.

Finally, the RRI has initiated the process of renewing the strategic plan for the Institute, which will lay out the vision and process to achieve this mandate over the coming years. As of May 1, 2017, the plan is in draft form, with anticipated completion by March 31, 2018.

## 5. Communications

In 2016, the RRI continued to communicate research findings to our stakeholders including ranchers, rangeland managers, academics, students, government and industry at several venues throughout the year. The RRI facilitates technology transfer of key environmental goods and services research results through field tours, online webinars, conferences, research publications, workshop presentations, popular press articles and a variety of other resources. Communication venues also allow rangeland-related undergraduate and graduate students opportunities to speak and engage with audiences and potential employers and contribute to their training as highly qualified personnel.



**MSc student shows her collection of native pollinators at the joint RRI & SRM field tour. Photo: Lisa Raatz**



**Undergraduate students learn about shelterbelts at Agroforestry field school. Photo: Scott Chang.**

In early July 2016, the RRI hosted pre-conference tours of the Kinsella and Mattheis Research Ranches for the 10<sup>th</sup> International Rangeland Congress with over 50 international visitors from across Australia, China, Africa, Europe, UK, USA and Canada. Those attending the Kinsella tour learned about aspen encroachment and historical uses of fire as a management tool, managing for smooth brome invasion, Roy Berg's hybrid cattle and participants toured the GroSafe cattle feeding system. Those touring Mattheis Ranch learned about grazing management under drought conditions, seedbank recovery following industrial disturbance, mitigation tools for industrial powerline construction techniques, and cattle behavior and genetics for low and high feed efficiency herds assessed in pasture settings. In mid-July in conjunction with the Society for Rangeland Management (SRM) annual summer meeting and University of Alberta Range Team reunion, the RRI hosted a field day at the Mattheis Research Ranch that was attended by more than 150 ranchers, rangeland managers, researchers, conservationists, and other interested persons. Those attending learned about research being conducted on the ranch assessing effects of linear landscape features on songbirds, mixedgrass disturbance ecology and beef cattle behavior, native pollinators on the prairies, tools for predicting invasive species, grazing interactions with drought, mitigation and assessment of grassland recovery following industrial disturbances, as well as grazing management on the Mattheis Ranch, and more.



**Tours prior to the International Rangeland Congress meeting (top) and RRI/Society for Rangeland Management annual summer meeting (bottom) where audiences learned about research on EG & S at the Mattheis Ranch. Photos: Lisa Raatz.**

Researchers affiliated with the RRI also presented their results at many events throughout 2016 (See Appendix II. Select presentations by RRI affiliates in 2016-17). This included oral and poster presentations to the Western Beef Development Centre,

Nature Conservancy of Canada, Saskatchewan Prairie Conservation Action Plan, Canadian Forest Service, Forage and Grassland Association, Ladies Lessons Learned Ranchers Forum, Canadian Society of Soil Science annual meeting, 70<sup>th</sup> annual International Meeting of the Society for Range Management, and the International Rangeland Congress, among many others. Collectively, these events continue to transfer knowledge about rangeland ecology, grazing management, and best management practices, and increase the profile of the RRI, the University of Alberta, and its Research Ranches.



**Australian ranchers try on a GPS collar worn by research cattle. IRC tour of Mattheis Ranch, July 2016.**

## **6. Strategic Advisory Council**

The Strategic Advisory Council (SAC) provides important insight and guidance to the Rangeland Research Institute's Director and staff on the vision, direction and activities of the RRI. The current composition of the SAC as of March 31, 2017 is provided in Table 1. The SAC held its annual meeting at the Mattheis Research Ranch in October 2016, during which members heard about the current activities of the RRI, both research and communications, and discussed future directions. The latter entailed a strategic planning session distributed across two days, in which in-depth discussions were held surrounding the short and long-term priorities for the RRI. This session was facilitated by Carole Starke, a strategic planning specialist. All input provided has been compiled for use in the development of the next Strategic Plan for the institute. A draft of the next strategic plan has been prepared, and will be finalized following the next meeting of the SAC in the fall of 2017.



**Table 1.** Members of the RRI Strategic Advisory Council, March 2017.

Name	Position, Agency	Location
Barry Adams*	Head, Rangeland Resource Management Program <i>Alberta Environment and Sustainable Resource Development</i>	Lethbridge, AB
Dr. Stan Blade	Dean, Faculty of Agricultural, Life & Environmental Sciences, <i>University of Alberta</i>	Edmonton, AB
Dr. Edward Bork	RRI Director; Professor and Mattheis Chair in Rangeland Ecology & Management, <i>University of Alberta</i>	Edmonton, AB
Jerry Brunen	Executive Director, <i>Western Sky Land Trust</i>	Calgary, AB
Dr. Cameron Carlyle	Assistant Professor, <i>University of Alberta</i>	Edmonton, AB
Cherie Copithorne- Barnes	Producer and Chief Executive Officer, <i>CL Ranches Ltd.</i>	Jumping Pound, AB
Floyd George	Producer; Director, <i>Eastern Irrigation District</i>	Gem, AB
Edwin Mattheis	Producer (Retired)	Calgary, AB
Ruth Mattheis	Producer (Retired)	Calgary, AB
Karen Raven	Agriculture Land Use Specialist, <i>Alberta Agriculture and Rural Development</i>	Edmonton, AB
Karen Schmid	Beef Production Specialist, <i>Alberta Beef Producers</i>	Calgary, AB
Josie Van Lent	Dean, Agricultural Sciences & Human Service, <i>Lakeland College</i>	Vermillion, AB
Dr. Walter Willms	Researcher (Emeritus), <i>Agriculture &amp; Agri-Food Canada</i>	Lethbridge, AB
Dave Zehnder	Producer; Program Coordinator, <i>Ecological Services Initiative</i>	Invermere, BC

\* Chair of RRI Strategic Advisory Council

## 7. Financial Overview

Operations of the RRI are supported by funding generated by the Mattheis Research Ranch in SE Alberta. A summary of the 2016-17 financial statement for the RRI is provided in Appendix III. RRI Financial Statement of Actuals, April 1, 2016 to March 31, 2017. This statement includes a review of income, primarily surface lease revenue from oil/gas activity and utility (powerline) development, as well as expenses. Expenses include costs associated with outreach and communications, administrative operations of the RRI including the Program Coordinator, ongoing secondary support of various research activities and capacity development, investments into the REMF (reviewed below) and the direct costs associated with the RRI - Competitive Grants Program.

The Rangeland Ecology and Management Fund (REMF) was established as an endowment in 2015, and included funding contributions from powerline construction, a contribution from the Alberta Beef Producers, and significant contributions associated with the placement of a conservation easement on the Mattheis Research Ranch. The current value of the REMF as of March 31, 2017 was \$5,761,324 (Appendix IV. Rangeland Ecology and Management Fund Financial Statement of Actuals, April 1, 2016 to March 31, 2017). Investments into the REMF have helped fulfill the University of Alberta obligation through the Alberta Land Trust Grant Program to invest in conservation initiatives at the Mattheis Research Ranch, and effectively leveraged contributions of RRI Research Affiliates as in-kind support for the conservation easement proceeds. The REMF will serve as a critical source of long-term funding for rangeland research, thus allowing the RRI to better fulfill its mandate.

## Appendix I. Summary of ongoing research projects led by RRI affiliates

All projects listed are being undertaken by various research affiliates associated with the RRI during 2016-17. \* Indicates projects that have received support from the RRI Competitive Grants Program.

Project Title	Principle Investigators
A proposal to conduct baseline archaeological research on the Kinsella and Mattheis Ranches*	Jack Ives
Mitigation of high voltage powerline construction on mixedgrass prairie	Edward Bork, Cameron Carlyle & Sylvie Quideau
Tools to guide management of invasive species in rangeland ecosystems*	Ellen Macdonald & Joyce Gould
Seedbank dynamics in rangelands relative to disturbance history	Edward Bork & Linda Hall
Mechanisms for smooth brome invasion and the possibility of an invasional meltdown*	James Cahill
Avi-fauna responses to land use disturbance in mixedgrass prairie	Scott Nielsen
Testing cow/calf feed efficiency under open-range grazing	Edward Bork, Graham Plastow, John Basarab, Colin Coros & Carolyn Fitzsimmons
Long-term monitoring of rangeland ecosystem functions on the Mattheis and Kinsella Research Ranches*	Cameron Carlyle
Agroforestry systems for reducing GHGs	Scott Chang, Edward Bork & Cameron Carlyle



Differentiating and understanding the roles of soil nutrient and soil community heterogeneity on plant growth, carbon storage and biodiversity*	James Cahill
Defoliation and altered precipitation effects on forage agronomy	Edward Bork
Defoliation and altered precipitation effects on soil microbial communities on the Mattheis Ranch*	Scott Chang
Assessment of altered precipitation and defoliation on rangeland EG & S	Cameron Carlyle, James Cahill & Edward Bork
Quantifying the carbon balance and associated ecosystem properties at the Mattheis Ranch*	John Gamon
Beef and biodiversity	Dan Farr, Edward Bork, Cameron Carlyle, James Cahill, Tim McCallister & Mike Alexander
GHG assessment in grasslands under contrasting grazing regimes	Cameron Carlyle, Edward Bork & Scott Chang
Effect of adaptive multi-paddock grazing on carbon storage and greenhouse gases	Mark Boyce, Richard Teague, Cameron Carlyle, Edward Bork & others
Biophysical quantification and mapping of soil quality at the Mattheis Ranch*	Guillermo Hernandez-Ramirez
Evaluating pollinators in Alberta rangelands	Cameron Carlyle & Jessamyn Manson
Nutrient cycling in rangelands under grazing regimes	Daniel Hewins, Edward Bork, Cameron Carlyle & Scott Chang

## Appendix II. Select presentations by RRI affiliates in 2016-17

**Table IIA.** Presentations of RRI-supported research at the 10<sup>th</sup> International Rangeland Congress Meeting, Saskatoon, SK, July 16 – 22, 2016.

Title (Format)	Presenter/Author(s)
A brief tour of Canada's rangeland and pasture resources (Oral presentation – Plenary speaker)	Bork
A framework for separating genetic and environmental influences on cattle performance on open-range pasture (Poster)	Moore, Lansink, Bork, Plastow, Nielsen, Basarab and Fitzsimmons
Access mats reduce Mixedgrass prairie soil physical responses to industrial traffic (Poster)	James, Bork, Carlyle, Najafi and Quideau
Impacts of high voltage powerline construction on Dry Mixedgrass Prairie (Poster)	Najafi, Bork, Carlyle, Quideau and James
Livestock grazing increase litter decomposition among plant species across Alberta rangelands (Poster)	Chuan, Hewins, Chang, Adams, Carlyle and Bork
Effects of cattle on bees in Alberta's rangelands (Poster)	Carlyle, Sturm, Kohler, Phung and Manson
Camera traps as a tool to estimate grazing intensity and effects on rangeland health and biodiversity (Poster)	Grenke, Mackintosh, DeMaere, Iravani, Nixon, Farr and Carlyle
No difference in greenhouse gas emissions from grazed and non-grazed temperate grassland soils (Poster)	Stolnikova, Hewins, Alexander, Willing, Chang, Bork, and Carlyle
Linking seed banks of tame, native and invaded Parkland pastures to historical and contemporary management practices (Oral presentation)	Pyle, Bork, and Hall
Dynamics of vegetation, biological soil crusts, and seed banks along pipelines in southern Alberta's Mixedgrass Prairie (Oral presentation)	Pyle, Bork, and Hall

**Table IIB.** Oral presentations of RRI-supported research at the 70th Annual International Meeting for Society for Range Management, St. George, UT, Jan 29 - Feb 2, 2017.

Title	Presenter/Author(s)
Breeding bird responses to roads and powerlines in the grasslands of southeastern Alberta	Martin, Nielsen, Bork
Exploring rangeland habitat use for cattle with divergent molecular breeding values for Residual Feed Intake	Moore, Lansink, Basarab, Fitzsimmons, Nielsen, Plastow, Bork
Testing performance of RFI-selected cattle under extensive cow/calf production systems	Lansink, Moore, Basarab, Fitzsimmons, Nielsen, Plastow, Bork

Duration of access mat application influences Mixedgrass prairie plant community cover and composition	James, Bork, Carlyle, Najafi, Quideau
Quantification of recreational trail effects to rangeland health using Google Earth as a monitoring tool	Grenke, Cahill, Bork

**Table IIC.** Other select outreach and promotional activities undertaken in support of the RRI during 2016-2017.

Abbreviated title	Presenter(s)	Venue	Audience(s)	Date
Overview of water research on Alberta grasslands	Bork	Agricultural Water Management Workshop	Resource managers, ranchers, government	May 2016
Testing the suitability of fractal hierarchical aggregation as a metric of soil quality and land stewardship	Kiani, Hebb, Hernandez-Ramirez, Schoderbek, Guenette, Puurveen, Bork, Smith, Janzen, Lamey	Canadian Society of Soil Science Annual Meeting	Academics, students, government, industry	May 2016
Current research on environmental goods and services in Alberta grasslands	Bork	Western Beef Development Centre	Ranchers, industry, government, academics	June 2016
Alberta's rangelands and ecosystem goods and services	Carlyle	Rancher's Rangeland Management Workshop, Nature Conservancy Canada	Ranchers, government, industry	June 2016
Linking rangeland health and livestock use to native bee diversity in Alberta grasslands	Sturm, Kohler, Sheffield, Manson, Carlyle	Canadian Society for Ecology and Evolution	Academics, students	June 2016
Assessing patterns in native bee communities across an agro-ecological gradient	Sturm, Kohler, Sheffield, Carlyle, Manson	Canadian Society for Ecology and Evolution	Academics, students, government, industry	June 2016
The effects of grazing on growth, reproduction, and pollination of an invasive legume	Phung, Manson, Carlyle	Canadian Society for Ecology and Evolution	Academics, students, government, industry	June 2016
<i>Field tour: Overview of research at Kinsella ranch</i>	Bork, Irving	10th International Rangeland Congress - Pre-tour	Ranchers, resource managers, academics, industry, government	July 2016



<i>Field tour: Overview of research at Mattheis ranch</i>	Moore, Lansink, James, Najafi, Pyle, Amgaa, Rajper, Carlyle, Bork	10th International Rangeland Congress - Pre-tour	Ranchers, resource managers, academics, industry, government	July 2016
<i>Field tour: Research at Mattheis Ranch</i>	Moore, Lansink, James, Najafi, Pyle, Martin, Nielsen, Kohler, Carlyle, Amgaa, Rajper, Armitage, Schroeder, Macdonald, Bork	Mattheis Open House/SRM summer meeting	General public	July 2016
Soil quality dynamics and spatial heterogeneity in grasslands and cropping systems of western Canada	Kiani, Hernandez-Ramirez	MSc thesis defense seminar	Academics, students	September 2016
Rangeland ecosystem goods and services: A review of current research efforts in Alberta	Hewins, Carlyle, Bork	7th Annual Canadian Forage and Grassland Association	Ranchers, resource managers, government	November 2016
Ecosystem goods and services in Alberta's grasslands	Carlyle	Saskatchewan Strategic Advisory Council on Forage and Crops	Ranchers, resource managers, government	November 2016
How well can remote sensing detect biodiversity?	Wang, Gamon, Springer	U of A GIS Day	Academics, students	November 2016
Spatial variability of plant available water, soil organic carbon, and microbial biomass under divergent land uses: comparing kriging methods	Kiani, Hernandez-Ramirez, Quideau	American Geophysical Union	Academics, students, government, industry	December 2016
The effects of defoliation on growth, reproduction and pollination of a non-native legume ( <i>Astragalus cicer</i> ) in the mixed grass prairie	Phung, Carlyle, Manson	U of A MSc defense seminar	Academics, students	January 2017
Carbon storage and greenhouse gas emissions in Alberta's grasslands	Carlyle	Winter workshop for Producers; Glaslyn, SK	Ranchers	January 2017

Access mats reduce mixed grass prairie soil physical responses to industrial traffic	James, Najafi, Quideau, Carlyle, Bork	2017 Bentley Lecture in Sustainable Agriculture	Academics, students	January 2017
Impacts of high voltage powerline construction on Dry Mixedgrass Prairie	Najafi, Bork, Carlyle, Quideau, James	2017 Bentley Lecture in Sustainable Agriculture	Academics, students	January 2017
Testing the suitability of fractal hierarchical aggregation as a metric of soil quality and land stewardship	Kiani, Hebb, Hernandez-Ramirez, Schoderbek, Guenette, Puurveen, Bork, Smith, Janzen, Larney	2017 Bentley Lecture in Sustainable Agriculture	Academics, students	January 2017
Dynamics of vegetation, biological soil crusts, and seed banks along pipelines in southern Alberta's Mixedgrass Prairie	Pyle, Bork, Hall	Native Plant Society of Saskatchewan: Native Plants in a Working Landscape	Government, students, academics, general public	January 2017
Sustainability and Alberta's grasslands	Carlyle	Ladies Livestock Lessons	Ranchers, resource managers, industry, government	January 2017
Leading by example: a science based program for sage grouse habitat restoration in Grasslands National Park	Watkinson, Naeth, Pruss, Liccioli, Wilkinson, Gardiner	Native Prairie Restoration and Reclamation Workshop	Government, students, academics, general public	February 2017
Biodiversity assessment of the Alberta beef industry	Bao, Farr, Bork, Carlyle	Native Prairie Restoration and Reclamation Workshop	Government, students, academics, general public	February 2017
Impacts of industrial disturbance on soil microbial communities in Mixedgrass Prairies of Alberta	Thompson, James, Najafi, Carlyle, Quideau, Bork	Native Prairie Restoration and Reclamation Workshop	Government, students, academics, general public	February 2017
Understanding carbon storage and greenhouse gas uptake in grasslands	Bork	Prairie Conservation Action Plan	Ranchers, government, industry, students, academics, general public	March 2017
Pollination in the Prairies	Manson	Prairie Conservation Action Plan	Ranchers, government, industry, students, academics, general public	March 2017

Impacts of industrial disturbance on soil and plant communities in southern Alberta	Thompson	Prairie Conservation Action Plan	Ranchers, government, industry, students, academics, general public	March 2017
Biodiversity in Alberta's grasslands	Carlyle	Prairie Conservation Action Plan	Ranchers, government, industry, students, academics, general public	March 2017
Sagebrush restoration for greater sage grouse habitat	Watkinson, Naeth, Pruss	Canadian Forest Service Reclamation and Restoration Research Symposium	Academics, professionals, students, government	March 2017
Dynamics of vegetation, biological soil crusts, and seed banks along pipelines in Southern Alberta's Mixedgrass Prairie	Pyle, Bork, Hall	ALES Graduate Research Symposium	Academics, students	March 2017
Using pedometers to explore activity of rangeland cattle with divergent molecular breeding values for Residual Feed Intake	Moore, Lansink, Basarab, Fitzsimmons, Nielsen, Plastow, Bork	ALES Graduate Research Symposium	Academics, students	March 2017
Performance of RFI selected cattle under extensive cow/calf production systems	Lansink, Moore, Basarab, Fitzsimmons, Plastow, Bork	ALES Graduate Research Symposium	Academics, students	March 2017
Understanding carbon storage and greenhouse gas uptake in grasslands	Thompson, Carlyle, Chang, Hewins, Bork	Southern Alberta Land Trust Annual Meeting	Resource managers, ranchers, government	March 2017



**Appendix III. RRI Financial Statement of Actuals, April 1, 2016 to March 31, 2017**

	<b>Actuals</b>
<b>Opening Balance</b>	<b>\$866,760.00</b>
<b>Revenue</b>	
Lease Revenue	\$473,614.75
Utility (Powerline) Revenue	\$45,578.00
<b>Total Revenue</b>	<b>\$519,192.75</b>
<b>Expenditures</b>	
Transfer to Endowment	\$897,348.00
Property Taxes	\$2,266.41
Academic Assistant	\$62,655.76
Temp Support Staff	\$39,515.35
Benefits <sup>1</sup>	\$17,755.99
Supplies	\$13,030.94
Hospitality	\$2,296.78
Travel Expenses	\$10,244.14
Rentals and Leases	\$19,486.43
Equipment	\$5,000.00
<b>Total Expenditures</b>	<b>\$1,069,599.80</b>
<b>Net Balance</b>	<b>\$316,352.95</b>
<b>Net After Benefits Adjustment<sup>1</sup></b>	<b>\$334,108.94</b>

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<sup>1</sup> University covered benefits at year end

*Note: This summary excludes U of A (in-kind) support to the RRI through academic staffing, which is currently valued at over \$250,000 annually*

**Appendix IV. Rangeland Ecology and Management Fund Financial Statement of Actuals, April 1, 2016 to March 31, 2017**

	<b>Actuals</b>
<b>Principal</b>	
Opening Balance (April 1, 2016) <sup>1</sup>	\$4,218,789.00
Contributions <sup>2</sup>	\$1,542,534.94
<b>Closing Balance (March 31, 2017)</b>	<b>\$5,761,323.94</b>
<b>Spending Allocation</b>	
Opening Balance (April 1, 2016)	\$127,368.79
Current Year Endowment Spending Allocation	\$145,342.18
Current Year Expenditure	(\$19,446.43)
<b>Closing Balance After Encumbrances<sup>3</sup></b>	<b>\$253,264.54</b>

<sup>1</sup>Opening balance from contributions in previous year (2015/2016): Conservation Easement (CE) Grant Transfer (\$3,168,789), Oil/Gas Utility Right of Way revenue (\$1,000,000), Alberta Beef Producers donation (\$50,000).

<sup>2</sup>\$897,348 of Mattheis oil and gas revenue was transferred to the endowment based on surplus revenue carried over from 2015/2016 and some revenue received in early 2016/2017. \$626,211 of the CE grant was transferred to the endowment. \$18,975.94 of endowment capitalization earnings.

<sup>3</sup>Closing balance from 2016/2017 is carried forward and available in 2017/2018 along with the 2017/2018 spending allocation.